Comparing Binary Search Trees and Red Black Trees

Project

October 31, 2023

As we have seen a *dictionary* data structure stores data, where each data item has a key and satellite data, and has three operations `insert`, `delete` and `search`. In this project we want to compare the use of the two data structures - binary search tree and red black tree - to store a dictionary under different sets of probabilities for the three operations. Our comparison will be based on

1. the number of key comparisons,
2. the number of data movement operarions,
3. the number of pointer assignments,
4. the number of new nodes created, and
5. the number of nodes deleted.

For our purposes, we will use integers as data, i.e., the key is an integer and there is no satellite data.

The probabilities for the three operations must be specified as fractions with values between 0 and 1.

Write a C++ program to compare the two data structures and write a report summarising your results, and your interpretation of the results.

Your program must have a class `BinSearchTree` and a class RedBlackTree, and any other helper classes that you need.

Your program must have a mechanism to clearly demonstrate that your program implements the data structures correctly. Your report should clearly

describe how your program demonstrates this. Simply stating that your program works on your test cases is not adequate. For each of your test cases you must clearly state what you would expect, and why you expect that outcome, if the data structures were implemented correctly. This could include the state of the tree at various stages of operating on the tree.

Your program can inlcude `iostream`, `fstream` `time.h` and `stdlib.h`. Your program cannot include any other libraries.

Your report must clearly state the parameters of your experiments, e.g., what sets of probabilities were used for the three operations, what data set sizes were used, how many iterations were performed to get averages, etc.

Your report must include your rationale for why you believe you have an exhaustive set of test cases.

Your results must be stated both graphically and in tabular form. Your interpretation of the results must refer to the graphs and tables to highlight salient aspects of the results.

Your report must be a PDF file.

As usual, your submission must be a tgz file that untars/ungzips (or a zip file that unzips) to a directory whose name contains your username. The directory must contain only the files relevant to the project: a README, your Makefile, your test case files, a file showing the expected results from each of your test cases, your program files (.cc and .h), your report (a PDF file) and any other files you need for the report (graphs, etc.). The directory must not contain any other files. **If any of these instructions are not followed, you will get 0 points for the Submission part of the grade.**

Grading Scheme

Test Cases	15%
Explanation of Demonstration of Correctness	10%
Correctness	35%
Style	15%
Report	20%
Submission	5%